

**Claims:**

What is claimed is

- 1        1. A method of testing an optoelectronic device including a VCSEL, said VCSEL having a cavity resonator formed by a relatively low reflectivity frontside reflector and a relatively higher reflectivity backside reflector, comprising the steps of:
  - 4              at an intermediate stage of its assembly, measuring an optical signal leaking through
  - 5              said backside reflector of said VCSEL,
  - 6              determining from the measured signal whether a selected quality of said VCSEL
  - 7              meets a predetermined specification, and then
  - 8              finishing said device in a configuration designed to use radiation emitted from
  - 9              said frontside reflector of said VCSEL.

1        2. The invention of claim 1 wherein said measuring step includes aligning a probe with  
2        said device and then measuring radiation leaking from backside reflectors of a multiplicity of  
3        VCSELs without performing another act of aligning said probe.

1        3. A method of testing a bottom-emitting VCSEL array at an intermediate stage of its  
2        manufacture, the VCSEL array including VCSELs each having a cavity resonator formed by a  
3        relatively low reflectivity frontside reflector and a relatively higher reflectivity backside  
4        reflector, comprising the steps of:

5        5        aligning a probe with one side of said VCSEL array, said probe including electronic  
6        circuits coupled to each of said VCSELs for causing said VCSELs to emit radiation and  
7        including photodetection circuits coupled to each of said VCSELs for detecting radiation leaking  
8        through each of said backside reflectors,

9        9        without performing another act of aligning said probe, determining from said detected  
10      10      backside radiation whether a selected quality of each VCSEL meets a predetermined  
11      11      specification, and then

12        12      for those VCSEL arrays that meet specification, finishing their manufacture in a  
13      13      configuration designed to use radiation emitted from said frontside reflectors.

1           4. The invention of claim 3 wherein said intermediate stage includes fabricating said  
2 VCSEL array on a substrate and said aligning and determining steps are performed without  
3 removing said substrate.

1           5. The invention of claim 4 wherein said finishing step includes removing said substrate  
2 before final assembly.

1           6. A method of testing a bottom-emitting VCSEL array at an intermediate stage of its  
2 manufacture, the VCSEL array including VCSELs each having a cavity resonator formed by a  
3 relatively low reflectivity frontside reflector and a relatively higher reflectivity backside  
4 reflector, comprising the steps of:

5           aligning a probe with said VCSEL array, said probe including a first array of electronic  
6 circuits coupled to one side of said VCSEL array and to each of said VCSELs for causing said  
7 VCSELs to emit radiation and including a second array of photodetection circuits, including  
8 photodetectors coupled to an opposite side of said VCSEL array and to each of said VCSELs for  
9 detecting radiation leaking through each of said backside reflectors,

10          without performing another act of aligning said probe, determining from said detected  
11 backside radiation whether a selected quality of each VCSEL meets a predetermined  
12 specification, said determining step including energizing said electronic and photodetection  
13 circuits in a fashion to reduce cross-talk between VCSELs and each photodetector, and then

14          for those VCSEL arrays that meet specification, finishing their manufacture in a  
15 configuration designed to use radiation emitted from said frontside reflectors.

1           7. The invention of claim 6 wherein said VCSELs are energized in a first predetermined  
2 sequence and said photodetection circuitry is energized in a second predetermined sequence so  
3 as to reduce cross-talk.

1           8. The invention of claim 7 wherein all of said VCSELs are energized concurrently, but  
2 said photodetection circuits are energized in a sequence that reduces said cross-talk.

1           9. The invention of claim 8 wherein said photodetection circuits are energized in a  
2 sequence that turns on a particular one of said circuits while concurrently turning off circuits  
3 adjacent thereto.

1           10. The invention of claim 7 wherein all of said photodetection circuits are energized  
2 concurrently, but said VCSELs are energized in a sequence that reduces said cross-talk.

1           11. The invention of claim 10 wherein said VCSELs are energized in a sequence that  
2 turns on a particular one of said VCSELs while concurrently turning off VCSELs adjacent  
3 thereto.

1           12. The invention of claim 7 wherein first groups of said VCSELs are energized in said  
2 first sequence and second groups of said circuitry are energized in said second sequence, with  
3 VCSELs in each of said first groups being energized concurrently with one another and circuits  
4 in each of said second groups being energized concurrently with one another.

1           13. The invention of claim 6 wherein said intermediate stage includes fabricating said  
2 VCSEL array on a substrate and said aligning and determining steps are performed without  
3 removing said substrate.

1           14. The invention of claim 13 wherein said finishing step includes removing said  
2 substrate before final assembly.

1           15. Apparatus for testing an optoelectronic device at an intermediate stage of its  
2 manufacture, said device including a VCSEL having a cavity resonator formed by a relatively  
3 low reflectivity frontside reflector and a relatively higher reflectivity backside reflector, said  
4 apparatus comprising:  
5           a probe including a photodetection circuitry for measuring an optical signal leaking  
6 through said backside reflector of said VCSEL, and  
7           means for determining from the measured signal whether a selected quality of said  
8 VCSEL meets a predetermined specification.

1        16. The invention of claim 15 further including means for aligning said probe with said  
2 device just once and wherein said photodetection circuitry measures radiation leaking from  
3 backside reflectors of a multiplicity of said VCSELs.

1        17. Apparatus for testing a bottom-emitting VCSEL array at an intermediate stage of its  
2 manufacture, the VCSEL array including VCSELs formed on a substrate, each VCSEL having a  
3 cavity resonator formed by a relatively low reflectivity frontside reflector and a relatively higher  
4 reflectivity backside reflector, said apparatus comprising:  
5              a probe including electronic circuits coupled to each of said VCSELs for causing said  
6 VCSELs to emit radiation and including photodetection circuits coupled to each of said VCSELs  
7 for detecting radiation leaking through each of said backside reflectors,  
8              means for aligning said probe just once with one side of said VCSEL array, and  
9              means for determining from said detected backside radiation whether a selected quality of  
10 each VCSEL meets a predetermined specification.

1        18. The invention of claim 17 wherein said aligning means and determining means  
2 function without removing said substrate.

1        19. Apparatus for testing a bottom-emitting VCSEL array at an intermediate stage of its  
2 manufacture when its substrate is intact, the VCSEL array including VCSELs each having a  
3 cavity resonator formed by a relatively low reflectivity frontside reflector and a relatively higher  
4 reflectivity backside reflector, said apparatus comprising:  
5              a probe including a first array of electronic circuits coupled to one side of said VCSEL  
6 array and to each of said VCSELs for causing selected ones of said VCSELs to emit radiation  
7 and including a second array of photodetection circuits, including photodetectors coupled to an  
8 opposite side of said VCSEL array and to each of said VCSELs for detecting radiation leaking  
9 through each of said backside reflectors,  
10             means for aligning said probe just once with said VCSEL array, and  
11             means for determining from said detected backside radiation whether a selected quality of  
12 each VCSEL meets a predetermined specification, said determining means including means for

- 13 energizing said electronic and photodetection circuits in a fashion to reduce cross-talk between  
14 VCSELs and each photodetector.

1        20. The invention of claim 19 wherein said probe energizes said VCSELs in a first  
2 predetermined sequence and said photodetection circuitry in a second predetermined sequence so  
3 as to reduce cross-talk.

1        21. The invention of claim 20 wherein said probe energizes all of said VCSELs  
2 concurrently, but energizes said photodetection circuits in a sequence that reduces said cross-  
3 talk.

1        22. The invention of claim 21 wherein said probe energizes said photodetection circuits  
2 in a sequence that turns on a particular one of said circuits while essentially simultaneously  
3 turning off circuits adjacent thereto.

1        23. The invention of claim 20 wherein said probe energizes all of said photodetection  
2 circuits concurrently but energizes said VCSELs in a sequence that reduces said cross-talk.

1        24. The invention of claim 23 wherein said probe energizes said VCSELs in a sequence  
2 that turns on a particular one of said VCSELs while concurrently turning off VCSELs adjacent  
3 thereto.

1        25. The invention of claim 20 wherein said probe energizes first groups of said VCSELs  
2 in said first sequence and second groups of said circuitry in said second sequence, with VCSELs  
3 in each of said first groups being energized concurrently with one another and circuits in each of  
4 said second groups being energized concurrently with one another.